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(54) SPUTTERING TARGET ASSEMBLY AND MANUFACTURE THEREOF

(57)Abstract:

PURPOSE: To prevent warping and improve joint strength by forge-cladding a preheated backing member and target member, at least one side of which is grooved, after one member is placed on top of the other.

CONSTITUTION: The grooves are provided on the surface of at least one side of the backing member consisting of Al (alloy) and Cu (alloy) and the target member consisting of stainless steel, Ti (alloy), Al (alloy) and Cu (alloy). After both members are preheated and made them at the temp. of a little below their melting point, both the members are laminated in a state where they are tightly adhered. Next, load is added to the members with a forging press or the like, the surface with the grooves is made to enter the other member and both the members are mechanically joined. The target assembly having joining strength larger than that by brazing or welding and without warping is obtained.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention is target plied timber (assembly) for sputtering which changes including supporter material and a target member. And it is related with the manufacture method.
[0002]
[Description of the Prior Art] It is known that the film of a metal or ceramics can be deposited on a substrate with the technology known as "magnetron sputtering." By such method, sputtering of a metal layer can be carried out in argon atmosphere, using as a cathode the target made with the material which should be deposited generally.
[0003] Furthermore, recently, sputtering technology is used for manufacture of the integrated circuit which needs to deposit a metal quickly and economically with a very small error. Sputtering is useful especially as a means for homogeneity and chemical purity forming an important film and an important coat. In the high-speed manufacture process typically used for manufacture of an integrated circuit, a manufacturing cost can be reduced by raising membranous homogeneity and the rate of sedimentation. In manufacture of an integrated circuit, especially important material is titanium, aluminum, and an aluminium alloy. In order to form a metaled film or a metaled coat by sputtering on a substrate, the target of titanium, aluminum, and/or an aluminium alloy is used.
[0004] About the sputtering method and equipment, they are others [GUMAN / bell] (Bergmann.). U.S. ****** of et al. No. 4,889,772 and this ** No. 4,962,831, U.S. ****** besides SHAGUN (Shagun et al.) No. 4,961,832, Others [nonuniformity / sima] (Shimamuraet al.) U.S. ****** No. 4,963,239, U.S. ****** besides NOBUTANI (Nobutani et al.) No. 4,964,962, U.S. ****** of ARITA (Arita) No. 4,964,968, U.S. Pat. No. 4,964,969 besides KUSAKABE (Kuksakabe et al.), U.S. ****** of HATA (Hata) It is indicated in No. 4,971,674 and the reference quoted by these. about the target for sputtering Others [regulus / full] (Furukawa et al.) U.S. Pat. No. 4,963,240 and this ** Others / ACHATTO / No. 4,966,676 and] (Archutet al.) U.S. ****** It is discussed by No. 4,966,677. The above-mentioned contents of an indication about the sputtering method, equipment, and a target are positively taken in also in this invention.
[0005] The target plied timber for sputtering is typically produced in the form where the target member was held on supporter material. The target member has the target front face made with the material by which a spatter is carried out, and supporter material is for holding a target member in the predetermined position in a sputtering system.
[0006]
[Problem(s) to be Solved by the Invention] One problem about target plied timber is that curvature (distortion) occurs by the heat input to the member joined during the manufacture. In the conventional target plied timber manufacture method, TIG arc welding, a hard soldering (brazing), soldering (soldering) by elevated-temperature brazing filler metal, or explosive joining (explosive bonding) was performing junction to a target member and supporter material. Generally by these methods, filler metal is used.

[0007] In conventional target plied timber, a round target is arranged on fixed supporter material, and it holds in the position by the above-mentioned methods, such as soldering, typically. Generally, when the target for sputtering is mechanically joined to the support plate (namely, welding, roll junction, or junction by explosive joining), it can equip and remove to a sputtering system by making the usually joined whole into a unit.
[0008] A round target is convenient because of circulation of cooling of target plied timber, and the cooling medium to target plied timber. however, the case where the quality of the materials of a target member and supporter material differ -- a member -- a problem may arise according to the difference of the coefficient of thermal expansion of comrades The soldering section deteriorates and target plied timber may be damaged at an early stage. Usually, since the melting point is comparatively low, the brazing filler metal (alloy) used for joining a target member and supporter material cannot be borne at an elevated temperature.
[0009] this invention aims at offering the new target plied timber for sputtering which solves the above-mentioned conventional problem and has the outstanding property and the outstanding performance, and its manufacture method.
[0010]
[Means for Solving the Problem] According to this invention, the target plied timber for sputtering is manufactured from a target member and supporter material. The method of this invention includes the process for which the target member which should be joined by forging junction, and supporter material are prepared. the target which it is going to join to supporter material -- a member -- by establishing a slot in a front face, it is advantageous to make a touch area with supporter material increase, and to promote the mechanical junction by the interface After preheating a target member and supporter material, "forging junction" is carried out with the forging press etc. Supporter material deforms under a forging load, supporter material and a target member will be in an adhesion state, and both mechanical junction will be performed. a target -- it is desirable to establish a slot at least in one side among a member and supporter material, and to make the surface area for additional mechanical junction increase The obtained coalesce object is heated and diffused junction of both the members is carried out.
[0011] In the desirable mode, supporter material is made from stainless steel, copper or a copper alloy, aluminum, or the aluminium alloy, and the target member is made from titanium, copper, or aluminum. the target by which diffused junction was carried out as mentioned above -- a member and supporter material are joined firmly and the joined fields form the joint of high intensity Even if the joint of the supporter material and target member by which diffused junction was carried out is strong and it compares it with roll junction rather than the junction depended for cursing conventionally, intensity matches upwards, it does not have the material loss at the time of a roll, and since the target plied timber joined by doing in this way can bear an elevated temperature, it can be used by higher power. It checked that the target plied timber produced as mentioned above could bear also with power level higher than 12kw(s).
[0012]
[Example] As already explained, while one material deforms the forging junction process of this invention more easily at an elevated temperature, the material of another side can be used to the combination of various material which has the sufficient intensity and sufficient ductility which can bear the load by which a load is carried out during the deformation. For example, titanium, aluminum and titanium, copper, and aluminum and copper are as a useful combination to manufacture the target plied timber for sputtering. If there are required relative intensity and relative ductility, combination other than these is also possible.
[0013] It being important in case this invention's is carried out in addition to the above explanation is that diffused junction is possible for the material to be used, and it is a desirable thing which diffused junction constitutes by within a time [rational] industrially and commercially after the first mechanical junction. By this method, the bonding strength in the interface between dissimilar materials improves. As one example of this invention, it is forging junction (forge cladding) to titanium and aluminum by the following procedure. It carried out.

[0014] The target member made from titanium and the supporter material made from aluminum were preheated at about 665 degrees F (about 352 degrees C). The grade of the used titanium and aluminum was the so-called aluminum of CP-2 titanium and "purity four nine" (99.99%), respectively. The slot was established in the front face which contacts the target member made from titanium to an aluminum member. The platen of a forging machine was heated at about 650 degrees F (about 343 degrees C), loss on ignition was made as small as possible, and the load of the maximum load of about 800t was carried out during forging. Where each part material is joined mechanically in this way, 500 degrees C and diffused-junction processing of 24 hours were performed. The result which measured the intensity of a total of six points about the various parts of the sample of a piece is shown in Table 1 after junction.
Table 1 Shear lug test result ---------- Test number Tensile strength (UTS) (psi [kgf/mm2]) ---------- 1 9,757 [6.83] 2 11,957 [8.37] 3 11,926 [8.35] 4 10,519 [7.36] 5 10,053 [7.04] 6 9,707 [6.79] ---------- averages 10,653 [7.46] ---------- preheat temperature and diffused-junction processing are the used material. Also in combination with a difference, for example, titanium, and aluminum, both change with cases where titanium is grade CP-2 etc., when aluminum is usually commercial material in the case of high grade material and titanium is 99.995% of hign grade material. About other combination like titanium and copper, preheat temperature differs from diffused-junction processing, and optimum conditions change with commercial restrictions, such as each facility, a size of the member to join, time for delivery, and installation specification.
[0015] As explained above, various change is possible for this invention, without deviating from the summary. That is, this invention is limited by only the claim.

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CLAIMS

[Claim(s)]
[Claim 1] The process which heats supporter material and a target member beforehand to an elevated temperature lower than these melting points, The process which changes into the state where front faces of each other were stuck the member and member by which the preheating was carried out [above-mentioned], and piles them up, the above -- a member -- the process which carries out the load of sufficient force to join comrades mechanically, and the above -- a member -- it changes including the process which forms the target plied timber for diffused-junction sputtering by carrying out diffused junction of the comrades -- The manufacture method of the target plied timber for sputtering which changes including supporter material and a target member.
[Claim 2] the aforementioned supporter material and a target -- one [at least] front face of a member -- a slot -- preparing -- this front face with a slot -- the member of another side -- carrying out the load of sufficient force entering inside -- the above -- a member -- the method according to claim 1 of including further the process which joins comrades mechanically
[Claim 3] The method according to claim 1 which is chosen from the group to which the aforementioned target member for sputtering changes from stainless steel, titanium, a titanium alloy, aluminum, an aluminium alloy, copper, and a copper alloy, and is chosen from the group to which the aforementioned supporter material changes from aluminum, an aluminium alloy, copper, and a copper alloy.
[Claim 4] the above according to soldering or welding by carrying out the load of the aforementioned force with the forging press -- a member -- the method according to claim 1 of forming the target plied timber for forging junction sputtering which has the large junction force rather than it is obtained by junction of comrades
[Claim 5] Target plied timber for sputtering which was manufactured by the method according to claim 4 of bearing larger sputtering power level than about 12 kw(s) and by which forging junction was carried out.
[Claim 6] Target plied timber for sputtering according to claim 5 which is chosen from the group to which the aforementioned target member changes from stainless steel, titanium, a titanium alloy, aluminum, an aluminium alloy, copper, and a copper alloy, and is chosen from the group to which the aforementioned supporter material changes from aluminum, an aluminium alloy, copper, and a copper alloy.

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PURPOSE: To prevent warping and improve joint strength by forge-cladding a preheated backing member and target member, at least one side of which is grooved, after one member is placed on top of the other.

CONSTITUTION: The grooves are provided on the surface of at least one side of the backing member consisting of Al (alloy) and Cu (alloy) and the target member consisting of stainless steel, Ti (alloy), Al (alloy) and Cu (alloy). After both members are preheated and made them at the temp. of a little below their melting point, both the members are laminated in a state where they are tightly adhered. Next, load is added to the members with a forging press or the like, the surface with the grooves is made to enter the other member and both the members are mechanically joined. The target assembly having joining strength larger than that by brazing or welding and without warping is obtained.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

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最終頁に続く

(54)【発明の名称】　スパッタリング用ターゲット合材およびその製造方法

(57)【要約】

【目的】　本発明は、支持部材とターゲット部材とを含んで成るスパッタリング用ターゲット合材およびその製造方法に関し、反りを防止し接合強度を向上させることを目的とする。

【構成】　支持部材とターゲット部材とをこれらの融点よりも低い高温に予熱する工程、上記予熱された部材と部材とを互いに表面同士を密着させた状態にして重ね合わせる工程、上記部材同士を機械的に接合させるのに十分な力を負荷する工程、および上記部材同士を拡散接合することにより拡散接合スパッタリング用ターゲット合材を形成する工程を含んで構成する。

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【特許請求の範囲】

【請求項1】　支持部材とターゲット部材とをこれらの融点よりも低い高温に予熱する工程、
上記予熱された部材と部材とを互いに表面同士を密着させた状態にして重ね合わせる工程、
上記部材同士を機械的に接合させるのに十分な力を負荷する工程、および
上記部材同士を拡散接合することにより拡散接合スパッタリング用ターゲット合材を形成する工程を含んで成る、支持部材とターゲット部材とを含んで成るスパッタリング用ターゲット合材の製造方法。

【請求項2】　前記支持部材とターゲット部材の少なくとも一方の表面に溝を設け、この溝付き表面が他方の部材中に入り込むのに十分な力を負荷することにより、上記部材同士を機械的に接合する工程を更に含む請求項1記載の方法。

【請求項3】　前記スパッタリング用ターゲット部材がステンレス鋼、チタン、チタン合金、アルミニウム、アルミニウム合金、銅および銅合金から成る群から選択され、前記支持部材がアルミニウム、アルミニウム合金、銅および銅合金から成る群から選択される請求項1記載の方法。

【請求項4】　前記力を鍛造プレスで負荷することにより、ろう付けあるいは溶接による前記部材同士の接合で得られるよりも大きい接合力を持つ鍛造接合スパッタリング用ターゲット合材を形成する請求項1記載の方法。

【請求項5】　約12kwより大きいスパッタリングパワーレベルに耐え得る請求項4記載の方法により製造された鍛造接合されたスパッタリング用ターゲット合材。

【請求項6】　前記ターゲット部材がステンレス鋼、チタン、チタン合金、アルミニウム、アルミニウム合金、銅および銅合金から成る群から選択され、前記支持部材がアルミニウム、アルミニウム合金、銅および銅合金から成る群から選択される請求項5記載のスパッタリング用ターゲット合材。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、支持部材とターゲット部材とを含んで成るスパッタリング用ターゲット合材（assembly）およびその製造方法に関する。

【0002】

【従来の技術】「マグネトロン・スパッタリング」として知られている技術によって基板上に金属やセラミックスの薄い層を堆積できることが知られている。このような方法では、堆積すべき材料でできたターゲットを一般にカソードとして用い、アルゴン雰囲気中で金属層のスパッタリングをすることができる。

【0003】更に最近では、極めて小さい誤差で迅速且つ経済的に金属の堆積を行う必要がある集積回路の製造にスパッタリング技術が用いられている。スパッタリングは、均一性と化学的純度とが重要である膜や皮膜を形成するための手段として特に有用である。集積回路の製造に典型的に用いられる高速製造プロセスにおいては、膜の均一性と堆積速度とを向上させることによって製造コストを低減することができる。集積回路の製造において特に重要な材料はチタン、アルミニウムおよびアルミニウム合金である。基板上に金属の膜あるいは皮膜をスパッタリングにより形成するために、チタン、アルミニウムおよび／またはアルミニウム合金のターゲットが用いられる。

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【0004】スパッタリング方法および装置については、ベルグマン他（Bergmann et al.）の米国特許第4,889,772号および同第4,962,831号、シャグン他（Shagun et al.）の米国特許第4,961,832号、シマムラ他（Shimamuraet al.）の米国特許第4,963,239号、ノブタニ他（Nobutani et al.）の米国特許第4,964,962号、アリタ（Arita）の米国特許第4,964,968号、クサカベ他（Kuksakabe et al.）の米国特許第4,964,969号、ハタ（Hata）の米国特許第4,971,674号、およびこれらで引用されている文献中に開示されており、スパッタリング用ターゲットについては、フルカワ他（Furukawa et al.）の米国特許第4,963,240号および同第4,966,676号、アーチャット他（Archut et al.）の米国特許第4,966,677号で議論されている。スパッタリング方法、装置、ターゲットについての上記開示内容は本発明においても積極的に取り入れてある。

【0005】スパッタリング用ターゲット合材は典型的にはターゲット部材を支持部材上に保持した形で作製されている。ターゲット部材はスパッタされる材料でできたターゲット表面を有しており、支持部材はスパッタリング装置内の所定位置にターゲット部材を保持するためのものである。

【0006】

【発明が解決しようとする課題】ターゲット合材についての一つの問題は、その製造中に、接合される部材への入熱によって反り（歪み）が発生することである。従来のターゲット合材製造方法においては、ターゲット部材と支持部材との接合をＴＩＧ溶接、硬ろう付け（brazing）、高温ろう材によるろう付け（soldering）、または爆発接合（爆着）によって行っていた。これらの方法では一般に溶加材が用いられている。

【0007】従来のターゲット合材では、丸いターゲットを固定支持部材上に配置し、典型的にはろう付け等の上記の方法によりその位置に保持する。一般に、スパッタリング用ターゲットが支持プレートに機械的に接合されている場合（すなわち溶接、ロール接合あるいは爆発接合による接合）、普通は接合された全体をユニットとしてスパッタリング装置に装着および取り外しすることができる。

【0008】丸いターゲットは、ターゲット合材の冷却

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予熱温度および拡散接合処理は用いた材料によって異なり、例えばチタンとアルミニウムとの組合せでも、両者とも高純度材の場合、アルミニウムが通常市販材の場合、チタンが９９．９９５%の高純度材の場合、チタンが等級ＣＰ－２である場合、等により異なる。チタンと銅のような他の組合せについても、予熱温度および拡散

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接合処理は異なり、最適条件は個々の設備、接合する部材の寸法、納期や設備仕様といった商業的な制約により異なる。

【００１５】以上説明したように、本発明はその要旨を逸脱することなく種々の変更が可能である。すなわち、本発明は特許請求の範囲によってのみ限定される。

フロントページの続き

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